

# [SWE3028\_41] Capstone Design Project

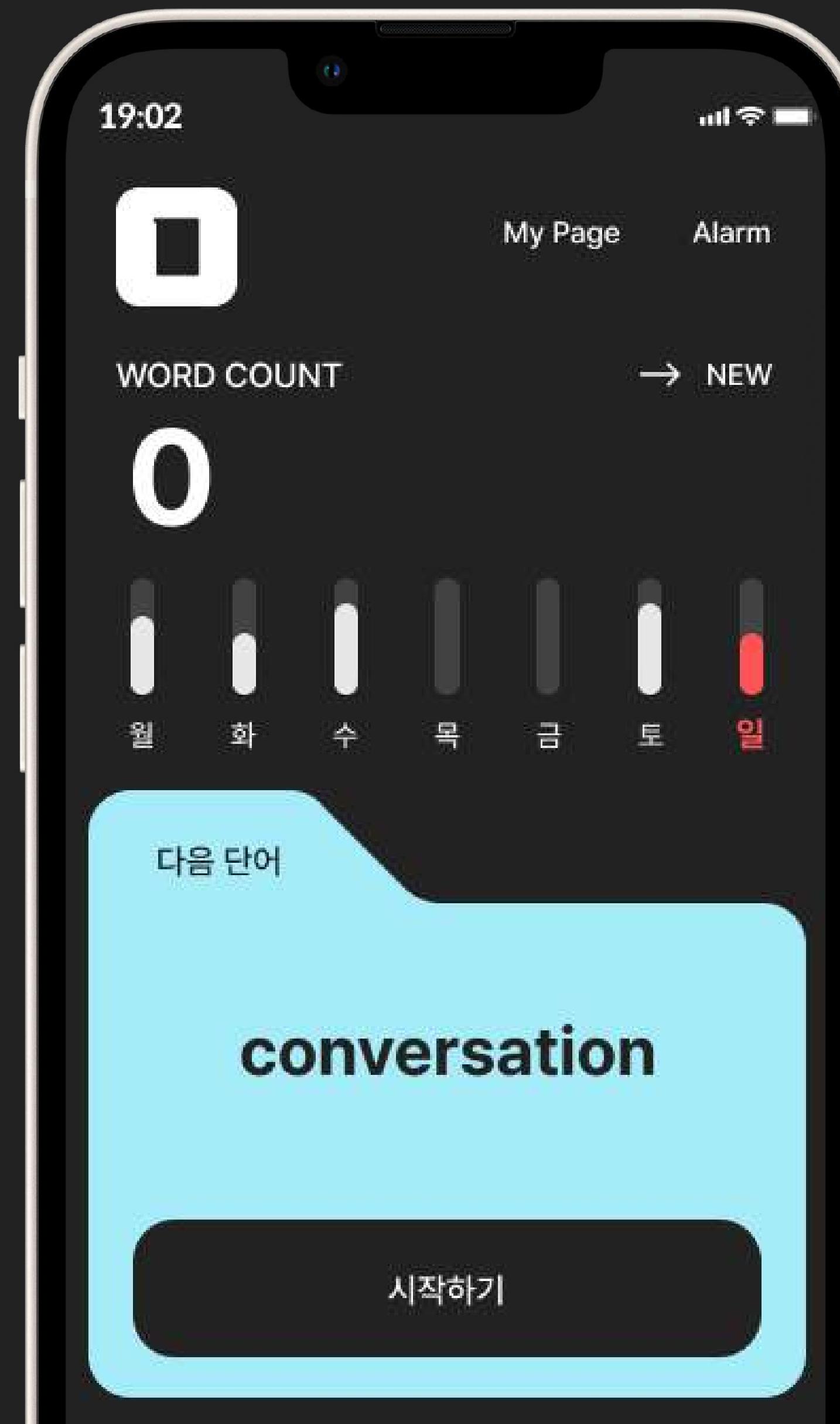
Midterm Presentation

## AI-based Vocabulary Application

D조  
김민지  
어영준  
조예현  
강창우

# VOCARD





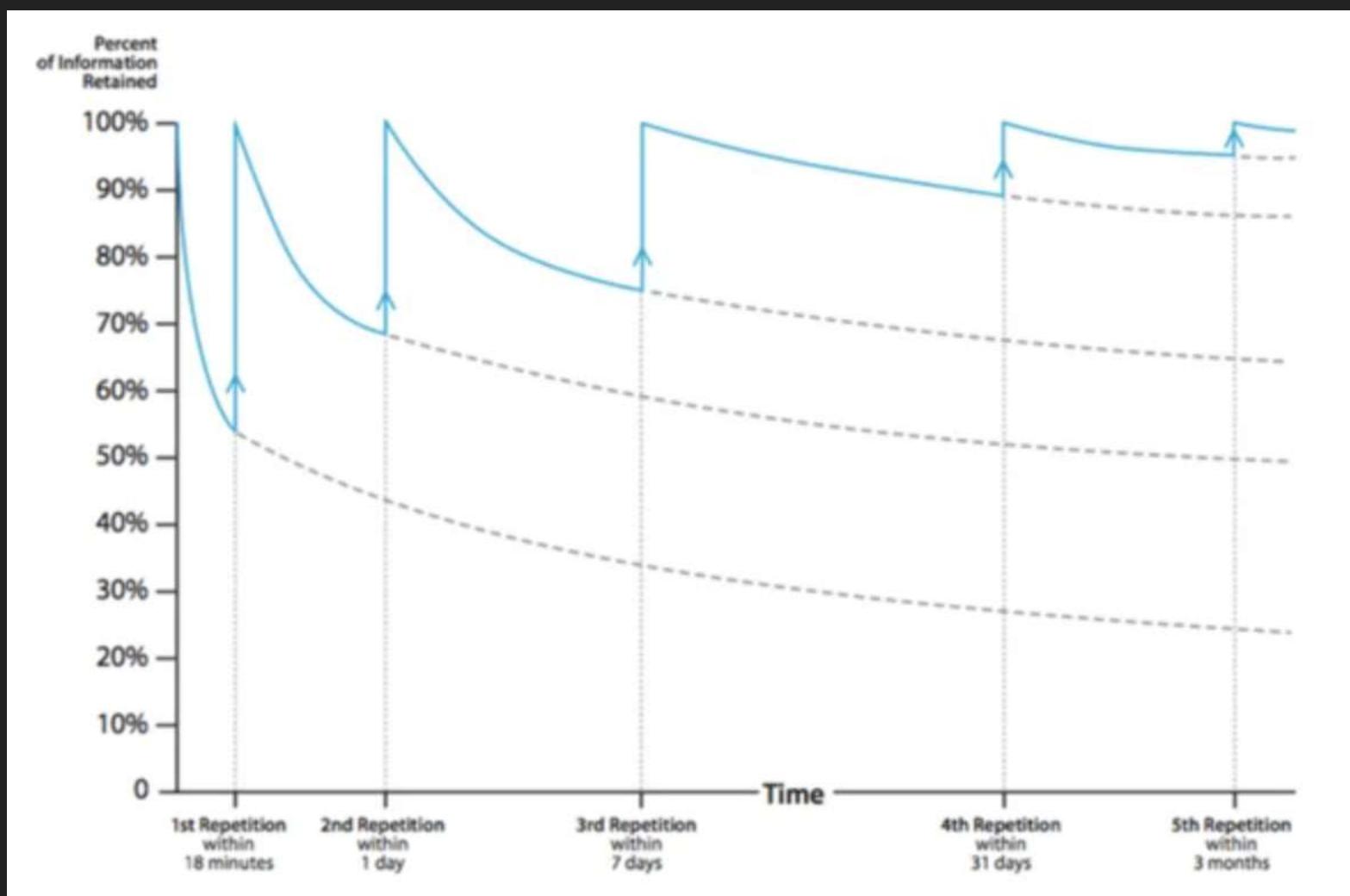
Vocabulary Learning Application that helps you learn English words efficiently with the help of powerful AI tools

# Project Goal

1. Minimize development costs

2. Maximize memorization efficiency

- Forgetting Curve



→ Rate of Forgetting with Study/Repetition

- Practical application of newly learned vocabulary



# System Features

Sign up --- Login

Kakao Login

Main

Daily goal  
Go to Study  
Go to History

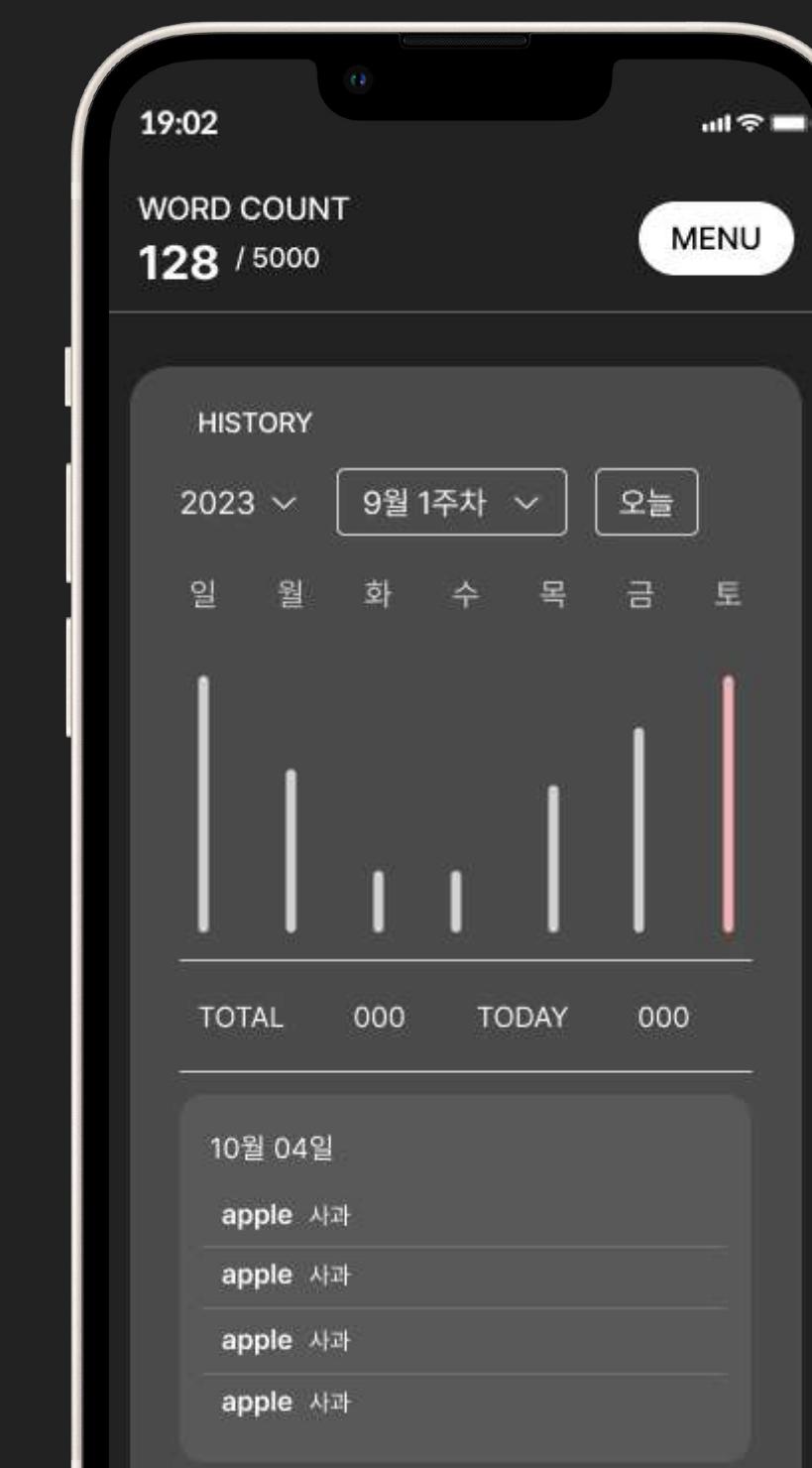
My Page

Repetition Alarm  
Daily Goal



Study

User learns words



History

Showing word data  
learned by date

# System Features

## Onboarding & Login

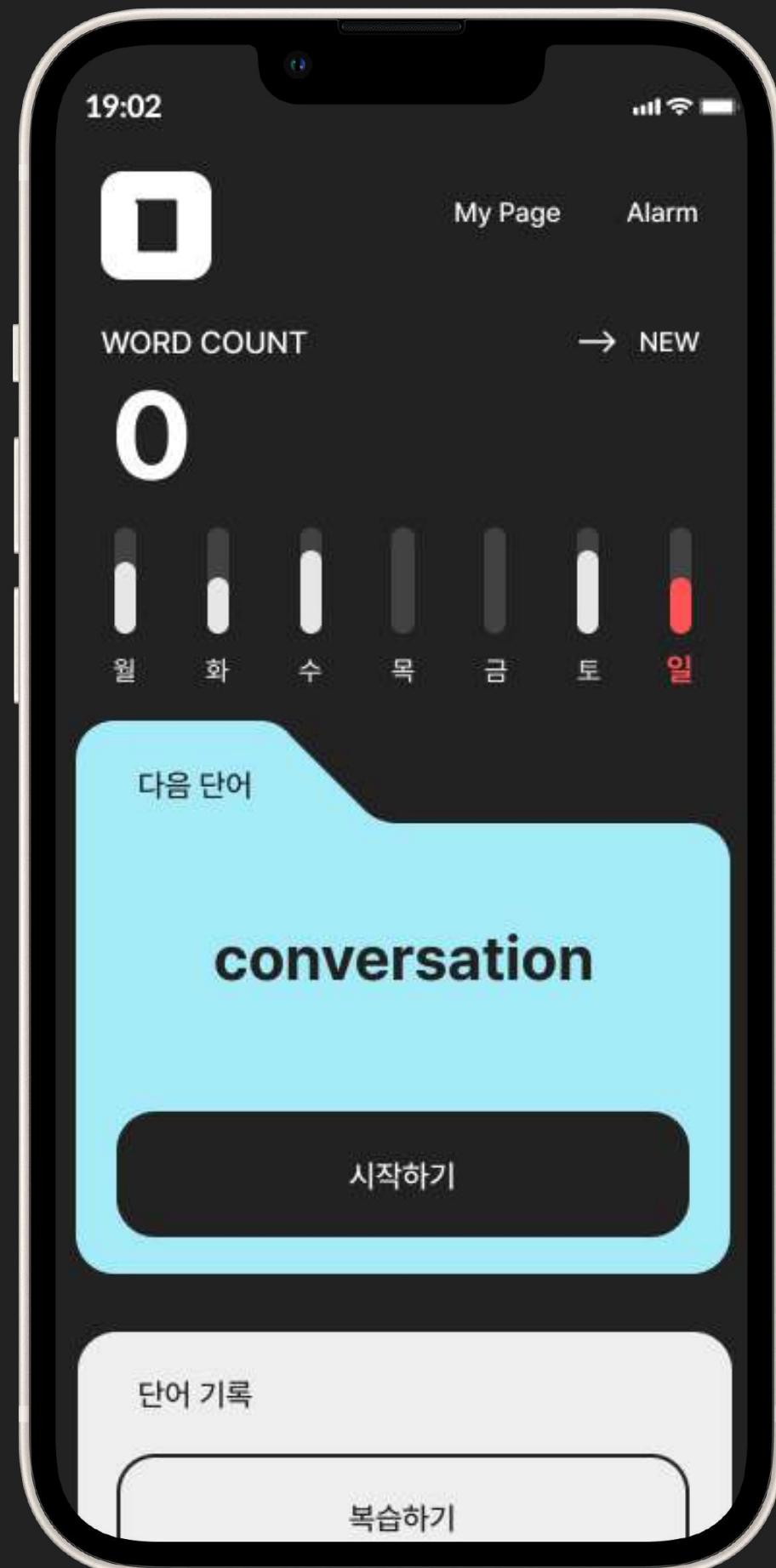


Quick and Easy Tutorial

Social Login For Quick and Easy Access

# System Features

## Main



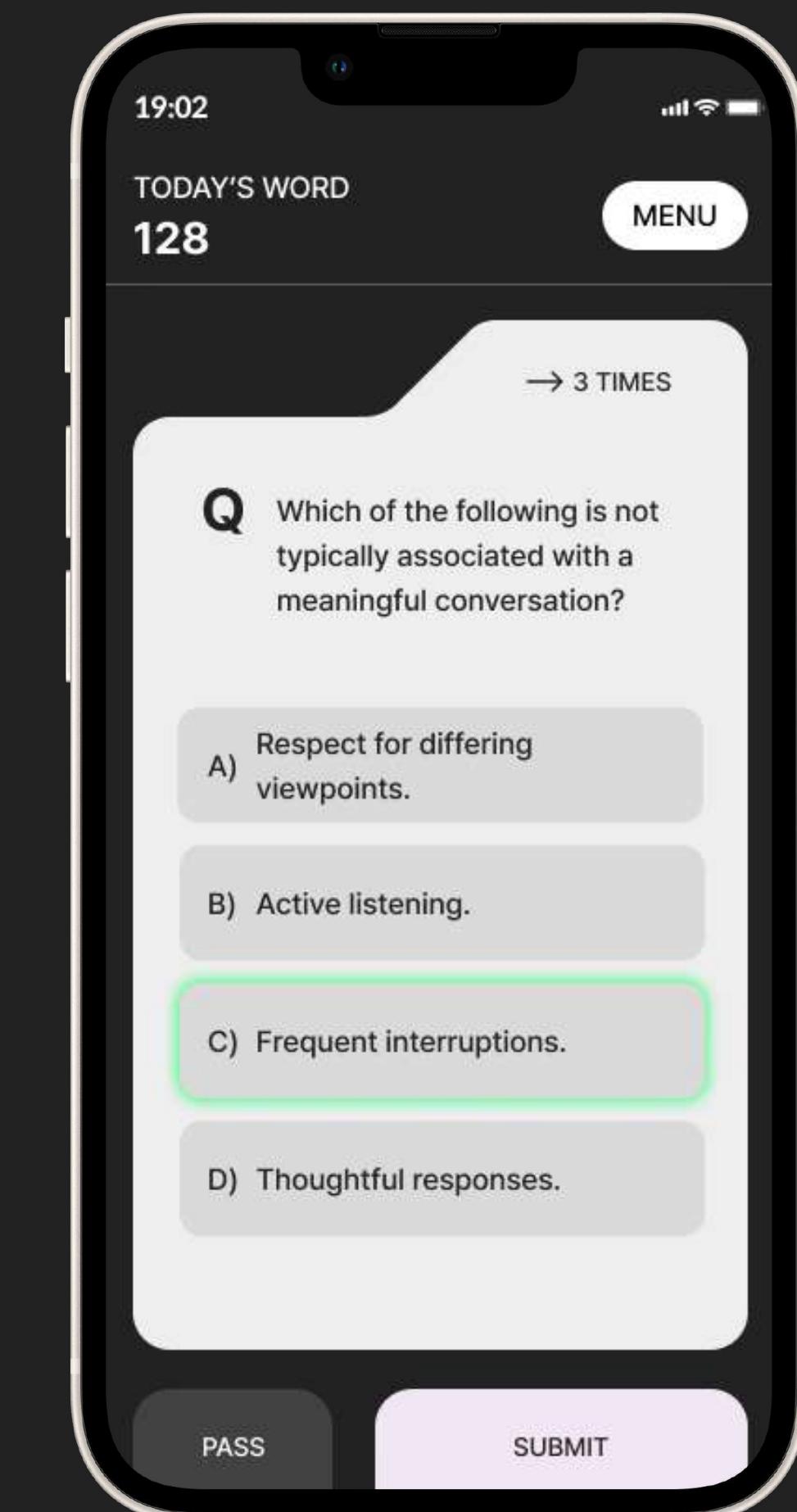
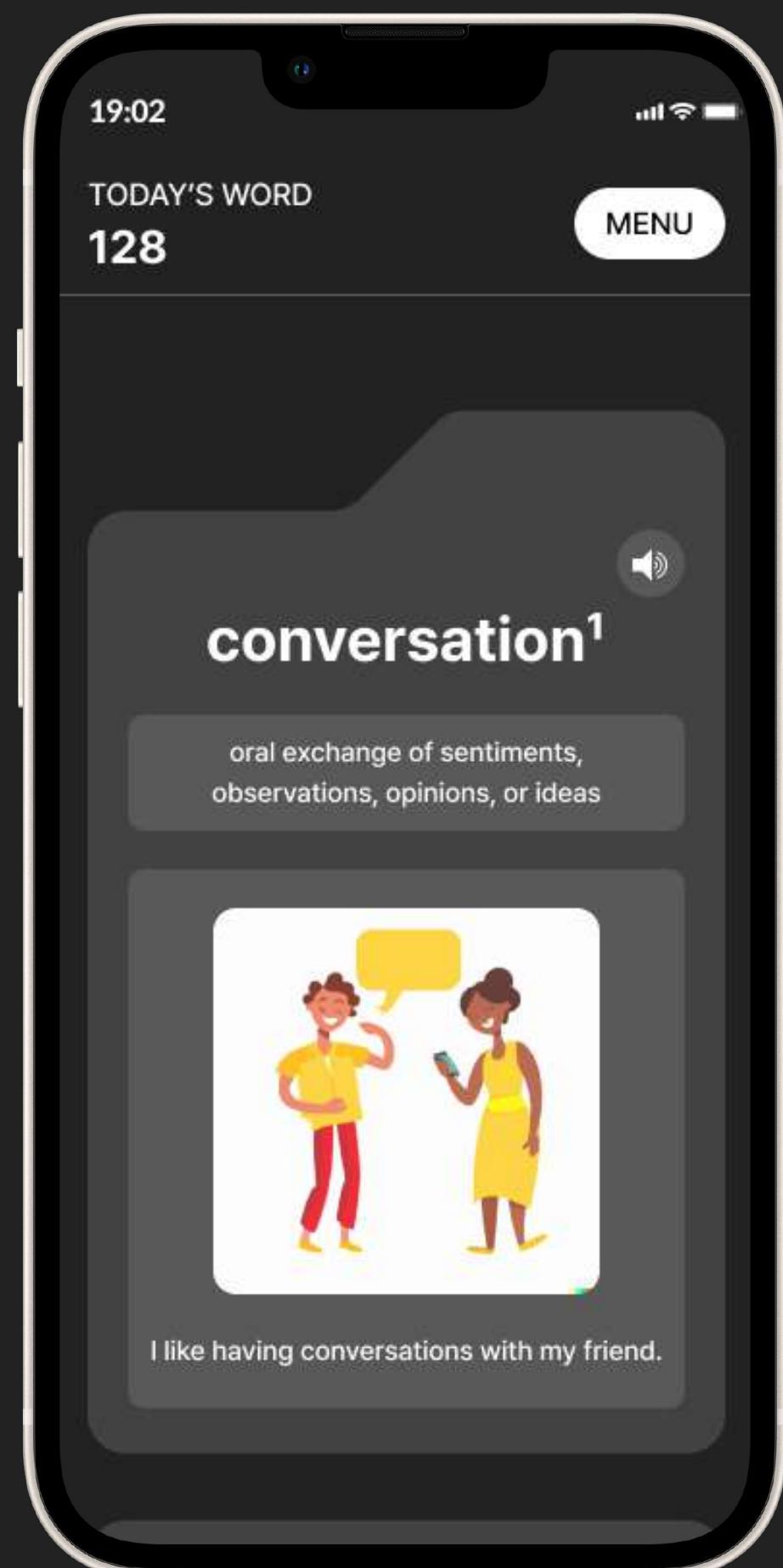
Track Daily Goal completion  
to motivate users

Study Feature: Sends Users to Study Page

Word History Feature : Sends Users to History Page

# System Features

## Study



# System Features

## History



- View Study History by Week

- Displays Words Studied Today

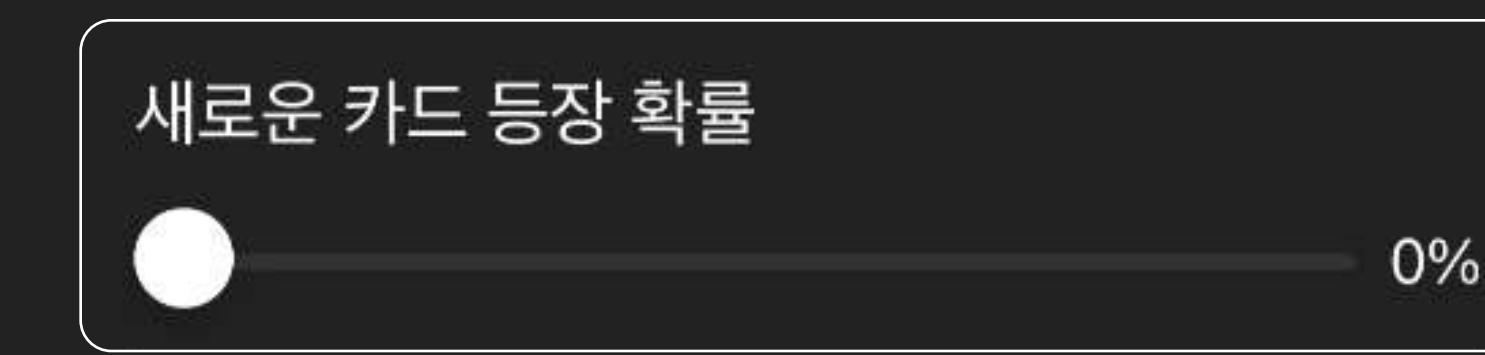
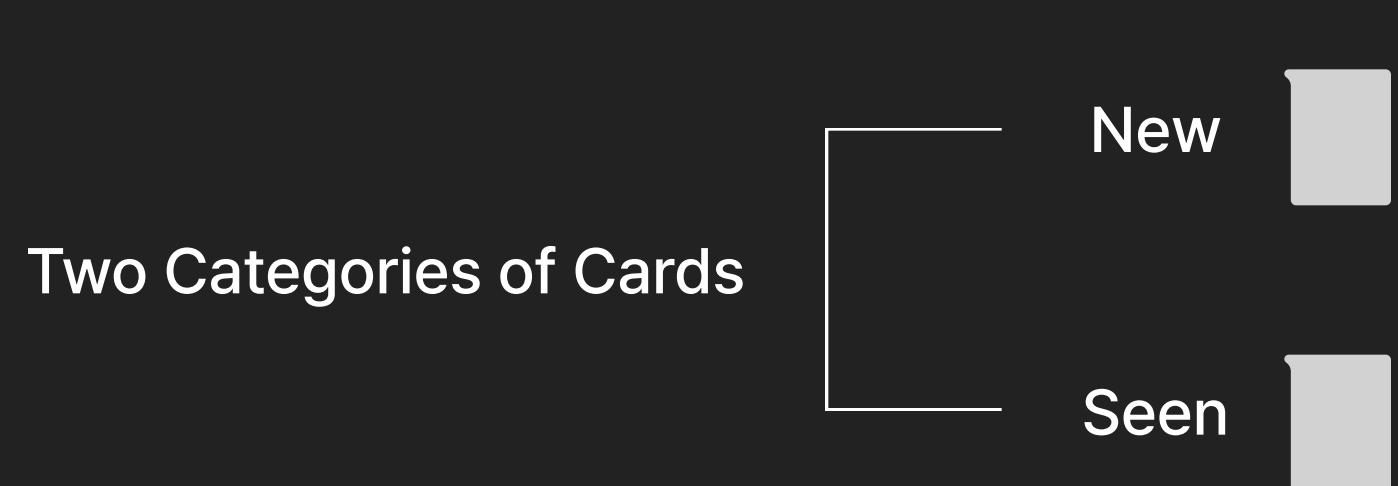
- Review Words Studied on a Certain Day

# Study System in Detail

## Card stack method

1. System provides the user with a card from the stack
2. Chance of a card being shown depends on an internal probability score

## Card Draw Probability



→ Cards to be shown are influenced by this probability setting

$\uparrow P_{\text{new}} = \downarrow P_{\text{seen}}$  (Inverse relationship)



# Study System in Detail

## Card Draw Probability cont.

$$P(\text{card}_i) = \begin{cases} \frac{1}{\text{number of cards with null recent review date}} & \text{if recent review date of } \text{card}_i = \text{null} \\ \frac{\text{Review Elapsed Time}(\text{SeenCard}_i)}{\text{Required Review Interval}(\text{SeenCard}_i)} \times \frac{1}{\sum_{k=1}^n \frac{\text{Review Elapsed Time}(\text{SeenCard}_k)}{\text{Required Review Interval}(\text{SeenCard}_k)}} & \text{otherwise} \end{cases}$$



# Study System in Detail

## Card Draw Probability cont.

$$P(\text{card}_i) = \frac{1}{\text{number of cards with null recent review date}} \quad \text{if recent review date of } \text{card}_i = \text{null}$$

Case 1 : If "recent review date" is NULL → show 1 card from the New category

$$P(\text{card}_i) = \frac{\text{Review Elapsed Time}(\text{SeenCard}_i)}{\text{Required Review Interval}(\text{SeenCard}_i)} \times \frac{1}{\sum_{k=1}^n \frac{\text{Review Elapsed Time}(\text{SeenCard}_k)}{\text{Required Review Interval}(\text{SeenCard}_k)}} \quad \text{otherwise}$$

Case 2 : Else → Show card based on elapsed time and review interval



# Study System in Detail

## Card Draw Probability cont.

| Word (word_name)   | w <sub>1</sub> | w <sub>2</sub> | ... | w <sub>n</sub> |
|--|----------------|----------------|-----|----------------|
| Last studied timestamp (last_studied)                            | t <sub>1</sub> | t <sub>2</sub> | ... | t <sub>n</sub> |
| Number of Times Relevant Quiz Solved in Succession (correct_cnt) | c <sub>1</sub> | c <sub>2</sub> | ... | c <sub>n</sub> |

Table 1. Table of fields in a word statistic information



# Study System in Detail

Card Draw Probability cont.

| Number of Times Relevant Quiz Solved in Succession (c) | 0             | 1  | 2  | 3             | 4             | 5              | 6   |
|--|---------------|----|----|---------------|---------------|----------------|-----|
| interval(c): Study Interval (hour)                     | $\frac{1}{2}$ | 12 | 24 | $24 \times 3$ | $24 \times 7$ | $24 \times 30$ | inf |

Table 2. Relationship between Successive count and Study Interval



# Study System in Detail

## Card Draw Probability cont.

$$P(\text{card}_i) = \frac{\text{Review Elapsed Time}(\text{SeenCard}_i)}{\text{Required Review Interval}(\text{SeenCard}_i)} \times \frac{1}{\sum_{k=1}^n \frac{\text{Review Elapsed Time}(\text{SeenCard}_k)}{\text{Required Review Interval}(\text{SeenCard}_k)}} \quad \text{otherwise}$$

→ last\_studied / interval(c)

→ 1/sum of the left side for all Seen cards

### Example

n = 3 (3 total Seen cards)

Review Elapsed Time(SeenCard<sub>1</sub>) = 1

Review Elapsed Time(SeenCard<sub>2</sub>) = 2

Review Elapsed Time(SeenCard<sub>3</sub>) = 3

Required Review Interval(SeenCard<sub>1,2,3</sub>) = 6

$$1. P_{\text{card1}} = (1/6) * (1/6 + 2/6 + 3/6)$$

$$2. P_{\text{card2}} = (2/6) * (1/6 + 2/6 + 3/6)$$

$$3. P_{\text{card3}} = (3/6) * (1/6 + 2/6 + 3/6)$$



# Milestones, Role & Tech Stack

## Design

Final design iteration completed

Minji Kim

## Frontend

Most of the page UI implementations are complete.

Yehyun Jo  
Changwoo Kang

## Backend

CRUD operations for most basic API endpoints completed

Young Joon Eo

\* Word image API not yet constructed

## [ Tech Stack ]

SwiftUI

Django Rest Framework

Google Firebase

Figma



# Design



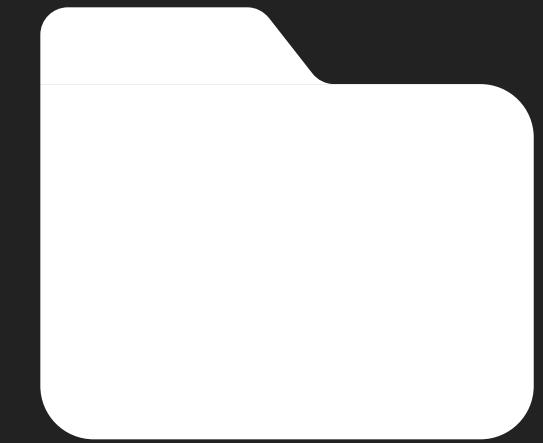
**Voca + Card**

Emphasize that card format memorizing word application

And designed using the edge shape of the card.



App Icon



Signature Style

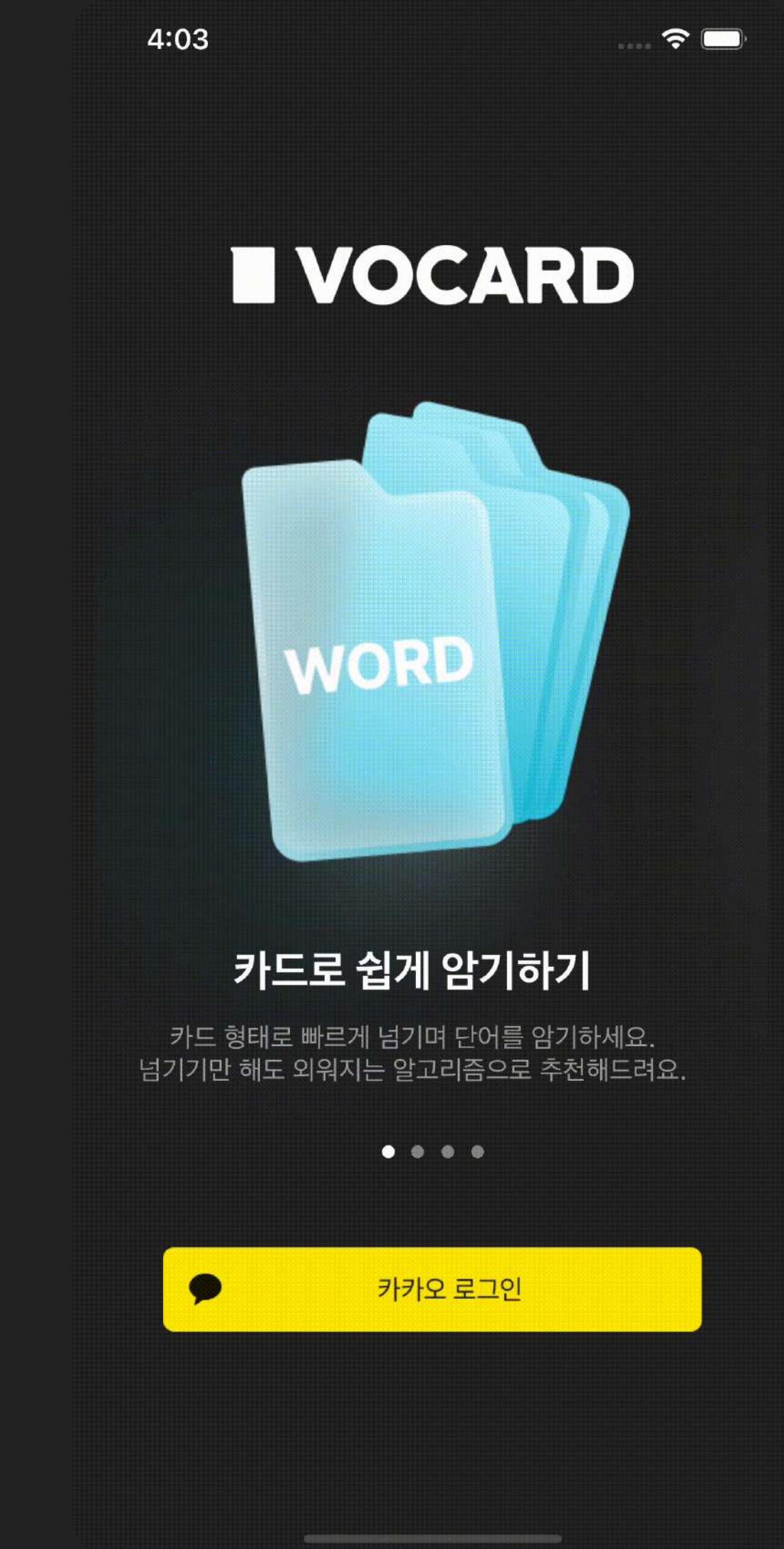


Onboarding Illustration



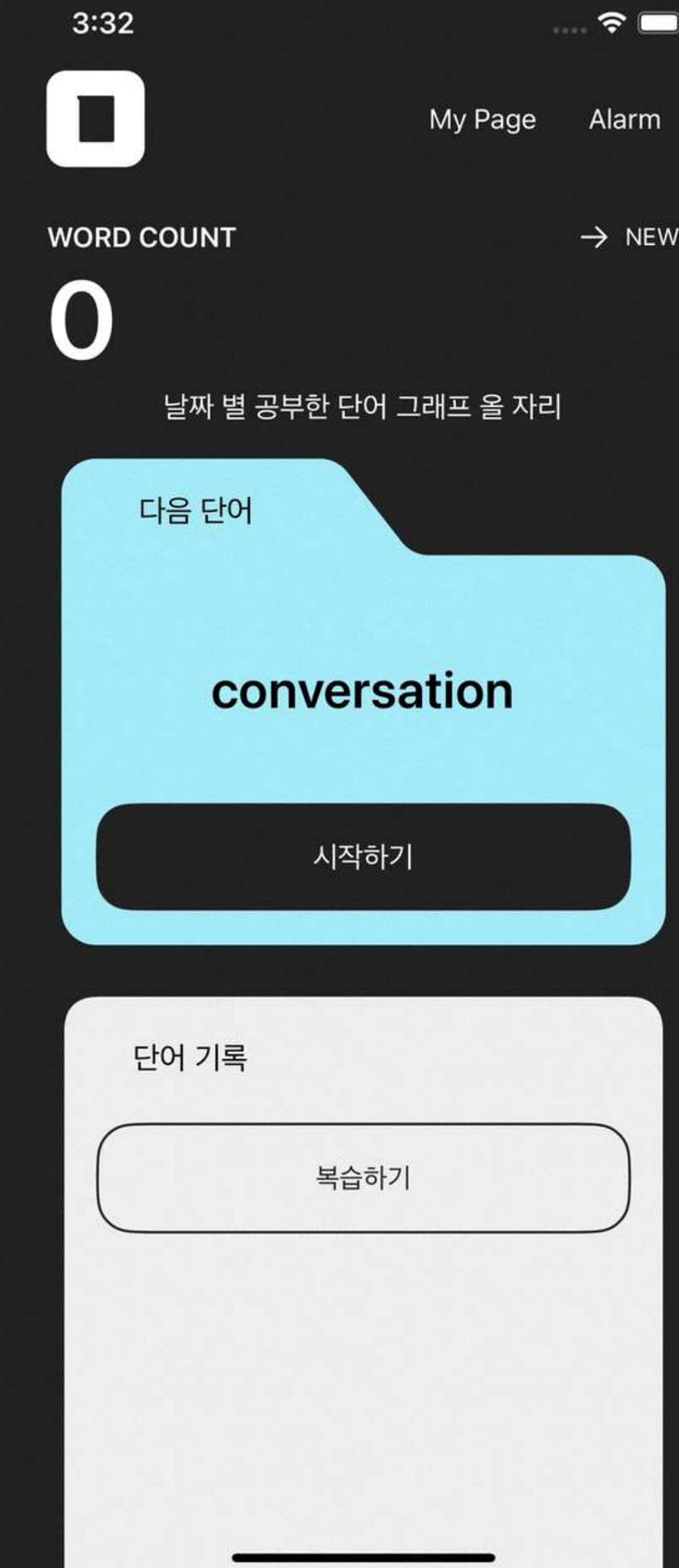
# Frontend

Click or Swipe for Login



# Frontend

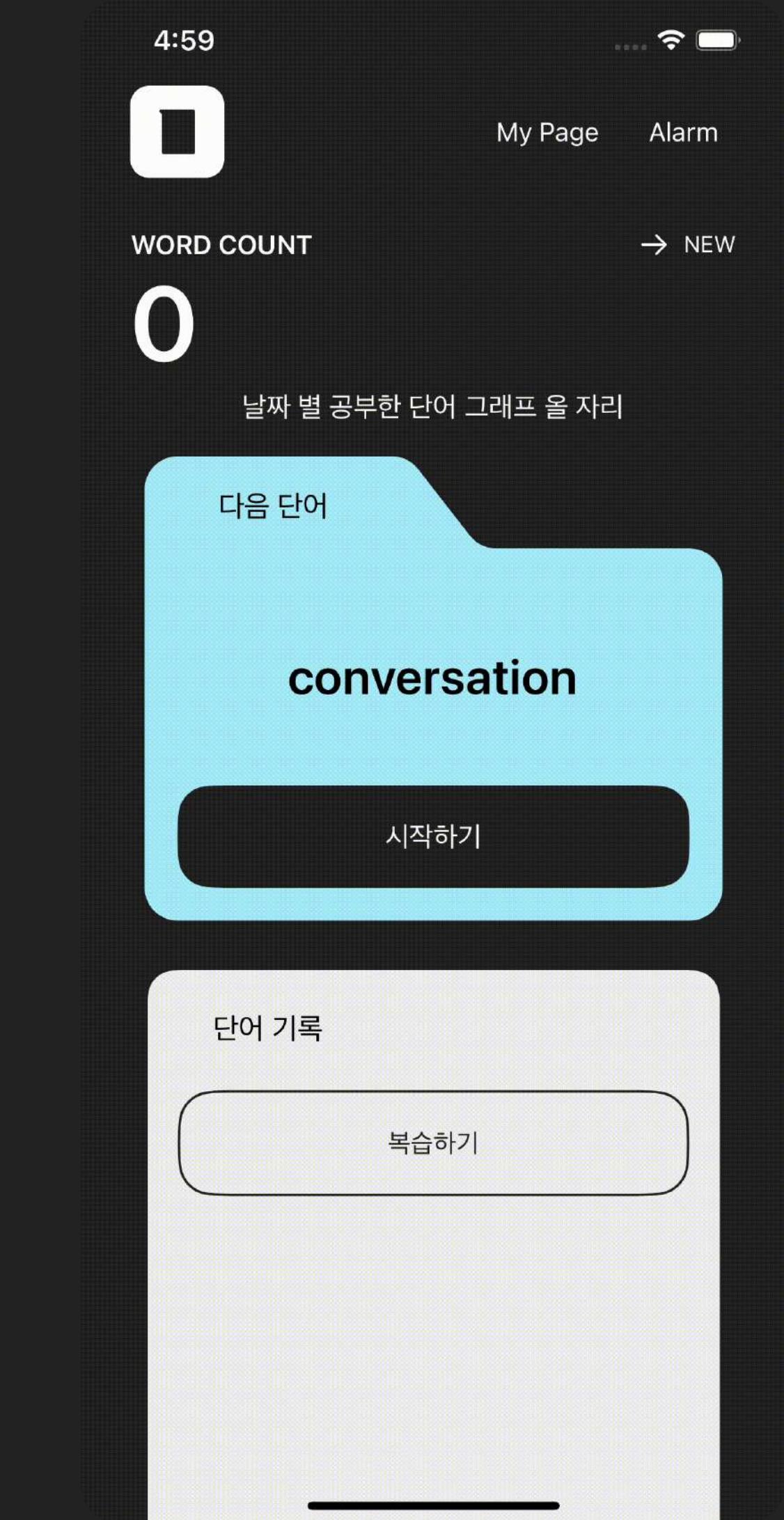
Click '시작하기' button to go to Study Page



**Go to Study**

# Frontend

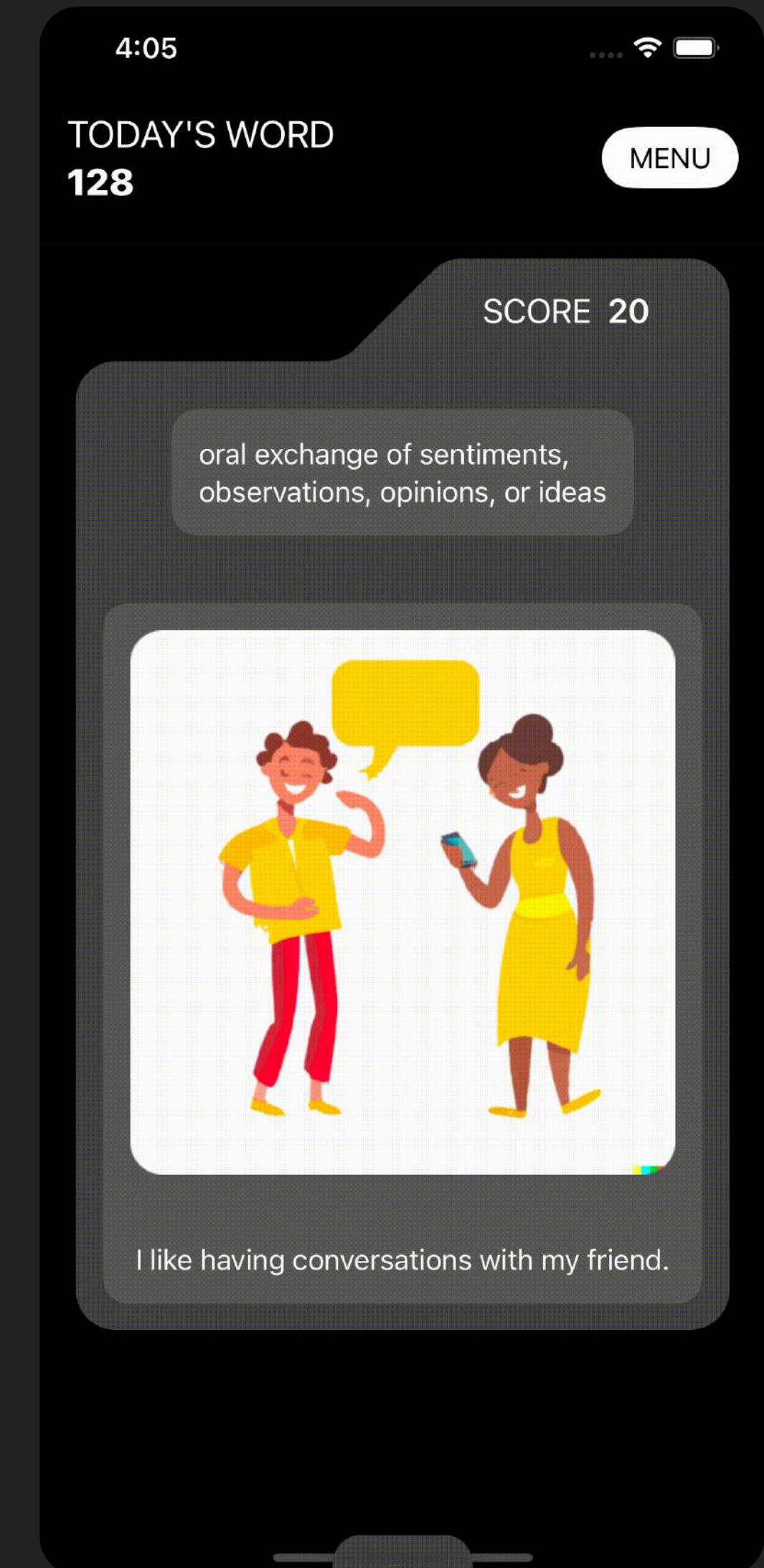
New Card Draw Probability



# Frontend

**Change the example sentence**

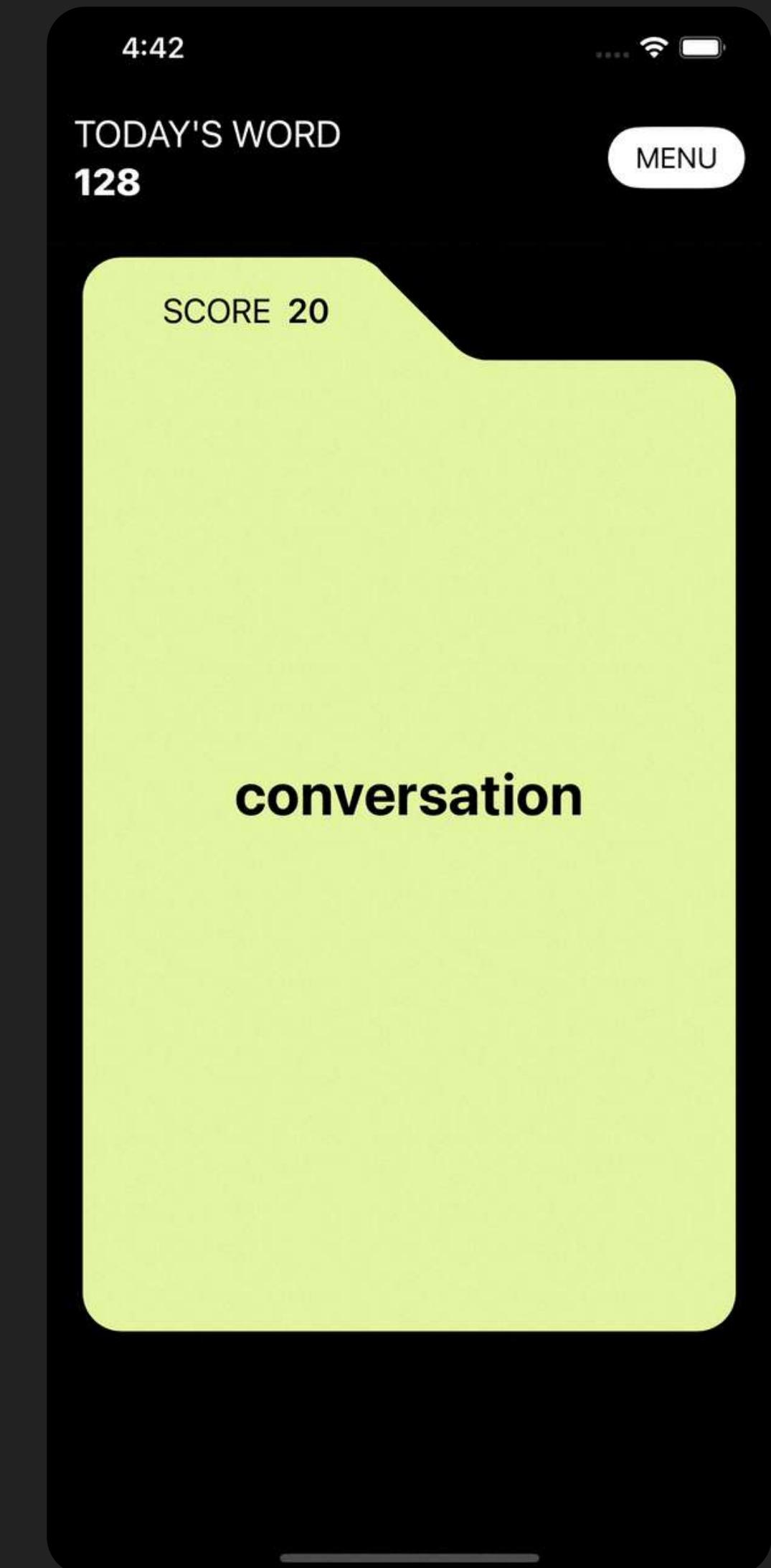
Press the image and change the example sentence



# Frontend

**Swipe the word card & Quiz**

swipe left for study and right for quiz



# Backend

## Database : NoSQL

Firebase: Realtime Database

Flexible for iterative development and changing requirements



Example



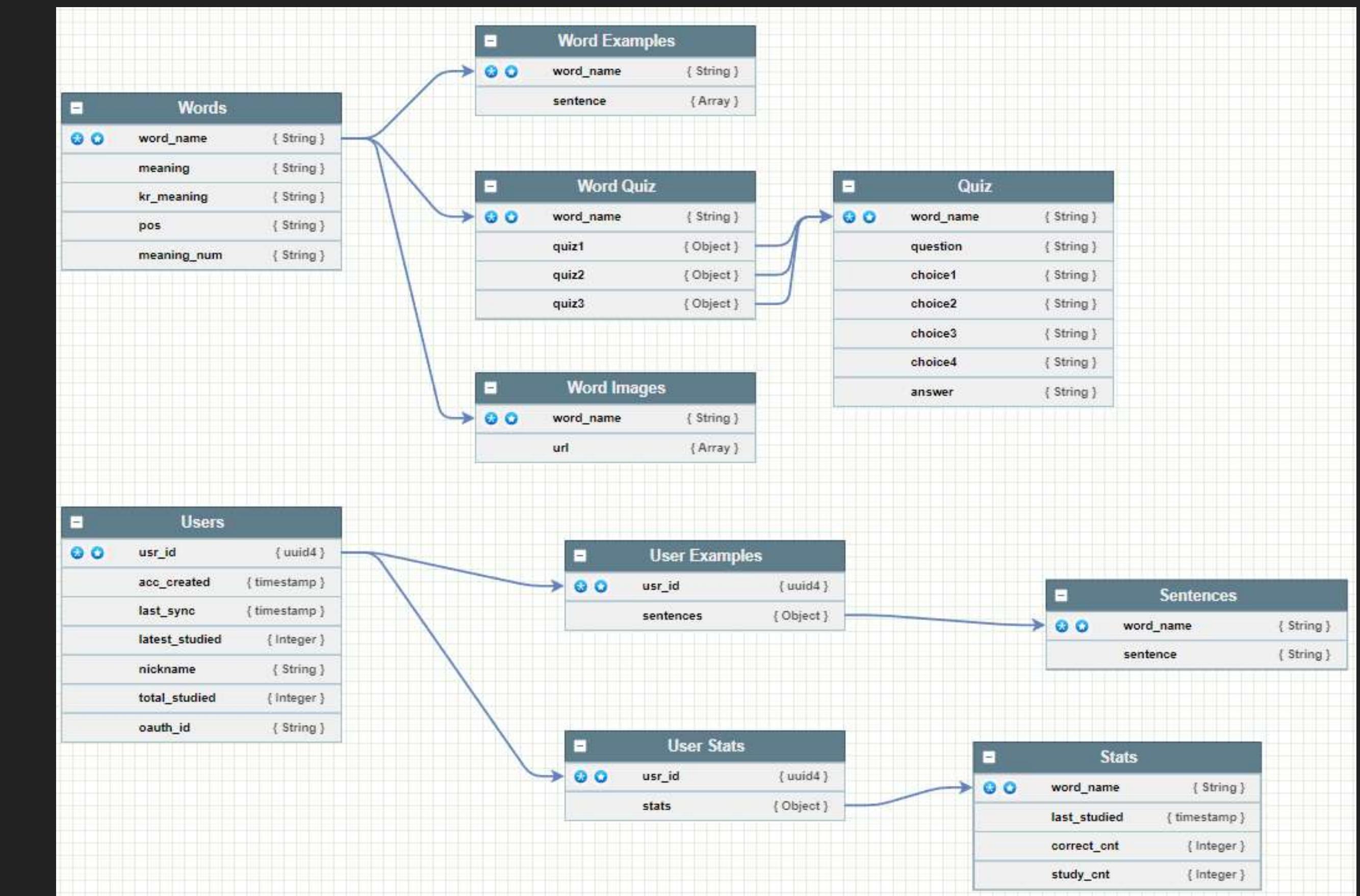
# Backend

## Schema

: Non-Relational Design Schema

: Server Hosting

- Currently in development
- EC2 to host Django App



# Backend

## Schema

### : REST API

- API documentation in progress
- Unit testing with each component done in tandem

| Component          | Method    | Endpoint                            | Function   |
|--------------------|-----------|-------------------------------------|--|
| Authentication     | GET       | /auth/users/                        | List all users   |
|                    | GET       | /auth/users/{usr_id}/               | Retrieve user information  |
|                    | GET, POST | /auth/kakao/login/                  | Sends a login request via Kakao OAuth                                    |
|                    | DELETE    | /auth/users/remove/{usr_id}/        | Deletes user's information   |
| DefaultWord        | GET       | /words/                             | List all words   |
|                    | POST      | /words/                             | Create new word entry  |
|                    | GET       | /words/{word_name}/                 | Retrieve word information  |
|                    | PUT       | /words/{word_name}/                 | Update word information  |
|                    | DELETE    | /words/{word_name}/                 | Delete word information  |
| DefaultWordExample | GET       | /examples/                          | List all word example sentences  |
|                    | POST      | /examples/                          | Create new word example sentences entry                                  |
|                    | GET       | /examples/{word_name}/              | Retrieve word example sentences information                              |
|                    | PUT       | /examples/{word_name}/              | Update word example sentences information                                |
|                    | DELETE    | /examples/{word_name}/              | Delete word example sentences information                                |
| DefaultWordQuiz    | GET       | /quiz/{num}/                        | List all quizzes in Quiz{num} object                                     |
|                    | POST      | /quiz/{num}/                        | Create new quiz entry for a certain word                                 |
|                    | GET       | /quiz/{num}/{word_name}/            | Get quiz information of a specific word in the specified quiz section    |
|                    | PUT       | /quiz/{num}/{word_name}/            | Update quiz information of a specific word in the specified quiz section |
|                    | DELETE    | /quiz/{num}/{word_name}/            | Delete quiz information of a specific word in the specified quiz section |
| UserStats          | GET       | /user-stats/{usr_id}/               | Get user's word stats  |
|                    | POST      | /user-stats/{usr_id}/               | Create user's word stats   |
|                    | GET       | /user-stats/{usr_id}/{word_name}/   | Get details of a user's certain word stats                               |
|                    | PUT       | /user-stats/{usr_id}/{word_name}/   | Update details of a user's certain word stats                            |
|                    | DELETE    | /user-stats/{usr_id}/{word_name}/   | Delete details of a user's certain word stats                            |
| UserExample        | GET       | /user-example/{usr_id}/             | Get user generated examples  |
|                    | POST      | /user-example/{usr_id}/             | Create a user generated example  |
|                    | GET       | /user-example/{usr_id}/{word_name}/ | Get a user generated example of a certain word                           |
|                    | PUT       | /user-example/{usr_id}/{word_name}/ | Update a user generated example of a certain word                        |
|                    | DELETE    | /user-example/{usr_id}/{word_name}/ | Delete a user generated example of a certain word                        |



# Challenges : Dall-E Image Generation

- Default word list image generation can be manually reviewed, but user generated sentence images cannot
- Prompting is important, but nuanced and tricky

Example : **"Conversation"**

Provided user sentence : **"I like having conversations with my friend"**

\* Images in the examples have been generated manually

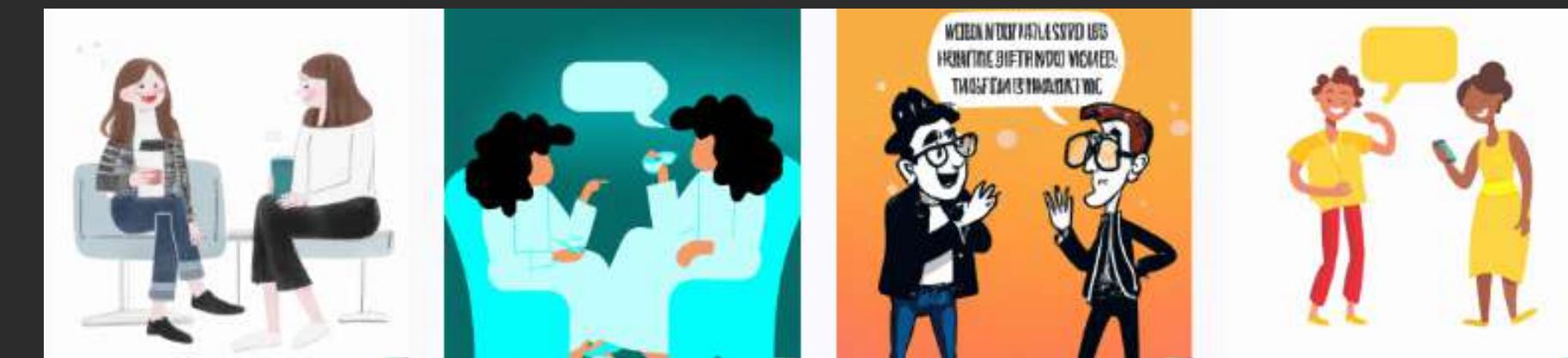
**Prompt 1** Simple prompting + user sentence

"Create an image that represents the phrase  
'I like having conversations with my friend.'"



**Prompt 2** ChatGPT generated prompt + user sentence

"Generate an image that vividly depicts two friends engaged in a heartfelt conversation, capturing the essence of  
'I like having conversations with my friend.'"



# Challenges : Dall-E Image Generation

How can we get more consistent picture generation? → Potential Solution: Dall-E 3

## Example 1 "Conversation"

"Generate an image that describes the following sentence:  
"I like having conversations with my friend"



## Example 2 "Bank"

"Generate an image that describes the following sentence:  
"The bank refused to check his check"



# Challenges : Dall-E Image Generation

## Points of Concern



### Prompt

Illustrate a scene at a bank where an individual is experiencing a moment of confusion and slight frustration, as the bank teller, with a polite yet firm expression, refuses to process his check. The setting is a traditional bank interior with customers in line and bank clerks working behind the counter. The individual, a young adult Caucasian male wearing a blue-collar shirt and denim jeans, is standing at the counter holding out a paper check towards the teller, a middle-aged African American woman wearing a professional bank uniform. The teller is shaking her head slightly, her hands raised in a gentle, declining gesture. On the counter, there's a sign that says 'Please ensure checks are correctly filled out before approaching the counter.' The bank's interior is clean, well-lit, and decorated with potted plants, giving it an official yet welcoming atmosphere.

 Copy

ChatGPT generated prompt



# Challenges : Dall-E Image Generation

## Points of Concern



Prompt

The bank refused to check his check

Copy

User sentence only prompt



# Challenges : Dall-E Image Generation

**May still need to go through ChatGPT to provide a suitable prompt for user generated sentence**

- Difference in the Quality of the Generated Prompt

GPT 3.5

SK make a dalle prompt that best depicts the following sentence: "The bank refused to check his check"

To generate a DALL-E prompt that best depicts the sentence "The bank refused to check his check," you can use a textual description that conveys the intended image. Here's a suitable prompt:

"Generate an image that shows a bank teller or employee declining to inspect or examine a check handed to them by a customer."

This prompt provides clear context and instructions for generating an image related to the sentence you provided.

GPT 4

SK make a dalle prompt that best depicts the following sentence: "The bank refused to check his check"

To depict the sentence "The bank refused to check his check" visually, we would need to create a scene that shows an interaction between a customer and a bank teller. Here's a prompt that could achieve this:

"Create an image showing a customer at a bank presenting a check to a teller. The customer is a young man, wearing casual attire, looking puzzled and slightly distressed. He is holding out a paper check towards the teller. The bank teller, who is behind the counter, has a look of apology and is gesturing 'no' with one hand, while in the other hand she holds a policy sign that says 'Non-verifiable checks cannot be processed.' The bank interior is modern and busy, with other customers waiting in line and bank clerks assisting them. The atmosphere is professional, and the situation seems to be handled calmly yet firmly by the bank staff."

- Might not be able to use for this project



# Challenges : English-Korean Definition Extraction

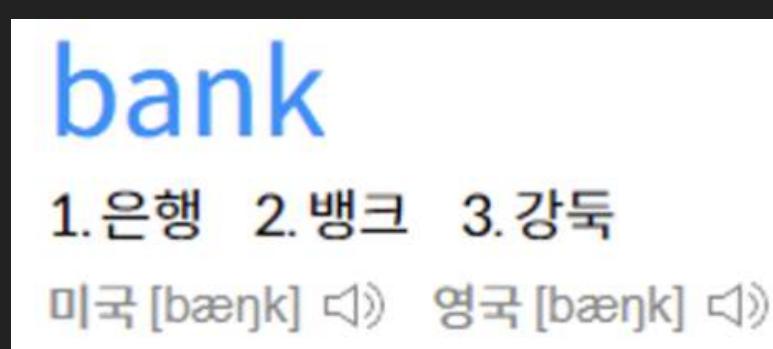
- Lack of APIs : Web Crawling is a potential solution
- But difficult to programmatically get the right definition

Example : "Bank"

meaning 1 - 은행 "an establishment for the custody, loan, exchange, or issue of money, for the extension of credit, and for facilitating the transmission of funds"

meaning 2 - 강둑 "the rising ground bordering a lake, river, or sea or forming the edge of a cut or hollow"

## Daum Dictionary



\* How can we programmatically get "은행" and "강둑" without these definitions being provided beforehand?

```

<span class="num_search">1.</span>
  <span class="txt_search">
    <daum:word id="kew000057014">은행</daum:word>
  </span>
</li>
<li>
  <span class="num_search">2.</span>
  <span class="txt_search">
    <daum:word id="kkw000107499">뱅크</daum:word>
  </span>
</li>
<li>
  <span class="num_search">3.</span>
  <span class="txt_search">
    <daum:word id="kew00001900">강둑</daum:word>
  </span>
</li>

```

## Naver Dictionary



\* Doesn't even have the Korean equivalent for our second definition in a reasonable location!

# Challenges : English-Korean Definition Extraction

## Solutions

Manual Review

ChatGPT : Most practical solution

Raises potential ethical concern : Vocabulary Definition Information from an AI vs. Official Dictionary



Sure, here are two definitions of "bank" in English and their Korean equivalents:

1. English Definition: A financial institution that provides various financial services, such as accepting deposits, lending money, and facilitating financial transactions.

Korean Equivalent: 은행 (eunhaeng)

2. English Definition: The rising ground bordering a lake, river, or sea, or forming the edge of a cut or hollow.

Korean Equivalent: 둑 (dook) or 둔치 (doonchi)



# Limitation: Dealing with Multiple Meanings

## Dealing with Multiple Meanings

Impractical to address all possible definitions of a certain word - "Run" has 645 definitions!

1

### bank 1 of 5 noun (1)

*'baŋk'*

[Synonyms of bank >](#)

1 : a mound, pile, or ridge raised above the surrounding level: such as

a : a piled-up mass of cloud or fog

| a fog *bank*

| a *bank* of dark clouds

b : an undersea elevation rising especially from the [continental shelf](#)

2 : the rising ground bordering a lake, river, or sea or forming the edge of a cut or hollow

| We lived along the *banks* of the Mississippi River.

3 a : a steep slope (as of a hill)

| climbed a steep *bank* up to the cabin

b : the [lateral](#) inward tilt of a surface along a curve

| The engineers hadn't given the road enough *bank*.

: the lateral inward tilt of a vehicle (such as an airplane) when turning

| The bomber crossed the target area in a sharp *bank*.

4 : a protective or cushioning rim or piece

2

### bank 3 of 5 noun (2)

1 a : an establishment for the custody, loan, exchange, or issue of money, for the extension of credit, and for facilitating the transmission of funds

| paychecks automatically deposited into the *bank*

| went to the *bank* to make a withdrawal

| open a *bank* account

b obsolete : the table, counter, or place of business of a money changer

2 : a person conducting a gambling house or game

specifically : [DEALER](#)

3 : a supply of something held in reserve: such as

a in games : the fund of supplies (such as money, chips, or pieces) held by the banker (see [BANKER entry 1 sense 2](#)) or dealer

b in games : a fund of pieces (such as dominoes) from which the players draw

| select another domino from the *bank*

4 : a place where something is held available

| *memory banks*

especially : a depot for the collection and storage of a biological product

| a *blood bank*



# Limitation: Dealing with Multiple Meanings

## Dealing with Multiple Meanings

3

### bank 5 of 5 noun (3)

- 1 : a group or series of objects arranged together in a row or a tier
  - | a *bank* of vending machines
  - | such as
  - a : a set of elevators
  - b : a row or tier of telephones
    - | worked at a phone *bank* calling potential donors
- 2 journalism : one of the horizontal and usually secondary or lower divisions of a headline
  - | reading the *bank* of the headline

4

### bank 2 of 5 verb (1)

- banked; banking; banks**  
*transitive verb*
- 1 a : to build a raised border of earth around : to raise a bank (see [BANK entry 1 sense 2](#))
    - | about
    - | *bank* a fishpond
  - b : to restrict the flow of air to (a fire) especially by piling ash around or over the burning embers
    - | They *banked* the campfire at midnight so it could be easily revived in the morning.
  - c : to build (a curve) with the roadbed or track inclined laterally upward from the inside edge
  - 2 : to heap or pile in a bank
    - | *banking* sand up along a river to prevent flooding
  - 3 a **billiards** : to drive (a ball) into a cushion
  - b **sports** : to bounce (a ball or shot) off a surface (such as a backboard) into or toward a goal
    - | *bank* in a rebound
  - 4 : to form or group in a tier



# Limitation: Dealing with Multiple Meanings

## Dealing with Multiple Meanings

5

### bank 4 of 5 verb (2)

banked; banking; banks

*intransitive verb*

1 : to manage a *bank*

2 : to deposit money or have an account in a bank (see *BANK* entry 3 sense 1a)

| choosing where to *bank*

*transitive verb*

: to deposit or store in a bank

| *bank* a check

| Whole blood ... could be *banked* indefinitely ...

| - Time



# Limitation: Dealing with Multiple Meanings

## Limit to two commonly used meanings per word

- Standard for “commonly used”?

Difficult to ascertain & out of scope of this project

→ Simplest solution: ChatGPT

What are two commonly used meanings of "instantiate"? If there is only one, reply with one.

Provide the English definition and the Korean equivalent word. Format your reply like this:

ENG DEF:

KOR:

Here are two commonly used meanings of "instantiate" with their Korean equivalents:

1. ENG DEF: To represent or create an instance or example of an abstract concept or class in a concrete form, typically in programming or computer science.

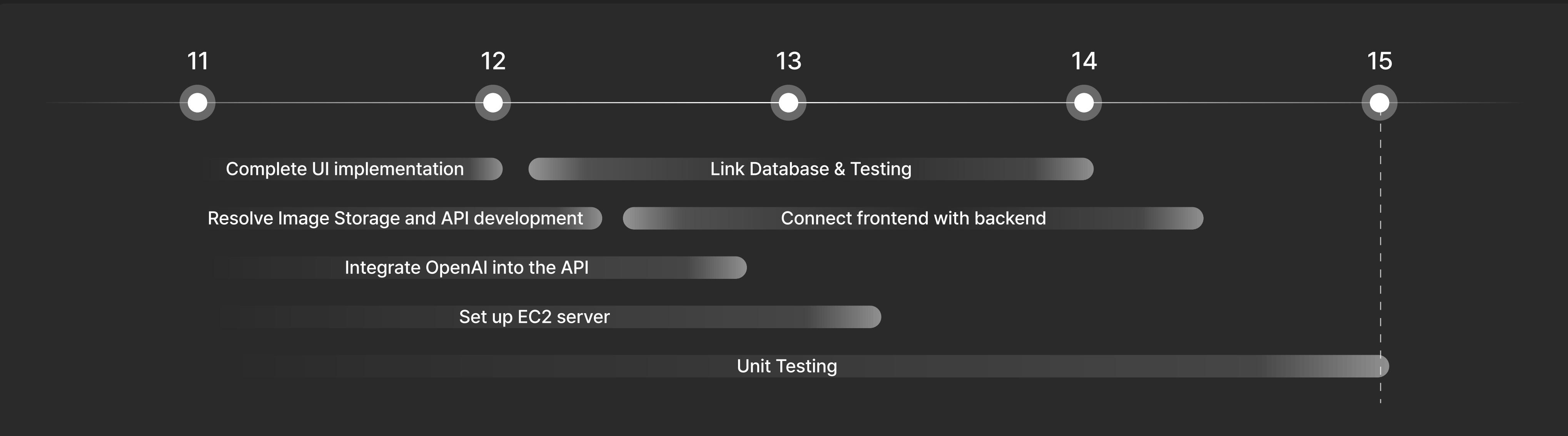
KOR: 구체화하다 (guchekehada)

2. ENG DEF: To provide a specific or real-world example that demonstrates the existence or application of a general concept or idea.

KOR: 실체화하다 (silchehwahada)



# Schedule & Future Plans



## Frontend

Complete UI implementation

Link Database & Testing

## Backend

API Documentation

Integrate OpenAI into the API

Set up EC2 server

Connect frontend with backend

Unit Testing





# Q&A

Thank you for listening